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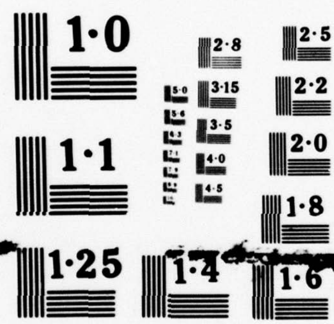

NATIONAL BUREAU OF STANDARDS
MICROCOPY RESOLUTION TEST CHART

ESD-TR-78-176, Vol. I

ESD E259, Volume 1 (of three)
Contract F19628-77-C-0212
Final Technical Report
January 1978

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LEVEL II

UNATTENDED RADAR STATION DESIGN FOR DEWLINE APPLICATION

EXECUTIVE SUMMARY

GENERAL ELECTRIC COMPANY

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DEPUTY FOR DEVELOPMENT PLANS
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Executive Summary is a very short synopsis of the "Unattended Radar Station Design Application" study to investigate the Feasibility of utilizing a string of Unattended Radars in the Arctic. The study is conceptual relative to design, installation, operation, maintenance and support of Unattended Stations and attendant problems such as security, reliability, maintainability, availability and life cycle cost. Cost drivers and problems are identified, and potential

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solution alternatives with recommendations presented.

The conclusion is that with reasonable development, economical Unattended Arctic Radar Stations are possible.

PREFACE

This report, prepared by the General Electric Company for Electronic Systems Division under Contract No. F19628-77-C-0212 was compiled by E. J. Gersten, Engineering Project Manager. Major contributors were W. E. Abriel, S. E. Bell, J. R. Golden, J. T. Gorham, R. M. Johnson and D. J. Murrow.

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SECTION I

INTRODUCTION

1) OBJECTIVE AND SCOPE

The primary objective of this study was to establish the technical and economical feasibility for a string of unattended radar stations along the DEWLine. This required an analysis of critical aspects associated with these stations such as design, operation, maintenance and support. In addition it required the development of preliminary design concepts which took into account the extreme environmental and geographical extremes to be encountered. It was necessary to develop alternatives and concepts which satisfied the requirements of these extremes and to provide a cost analysis for twenty year life cycle cost.

The study was limited to a baseline system consisting of 83 unattended radar stations (with maintenance nodes) extending eastward from Cape Lisburne, Alaska to Cape Dyer, on Baffin Island, then south to St. Anthony, Newfoundland. The study did not include consideration of Greenland Ice stations or further exercises pertaining to radar type mixes, DEWLine relocation, and additional site selections. Existing site data was evaluated to establish typical statistical distribution of characteristics effecting concept development and life cycle cost. Unattended station designs and model concept development was limited to implementation through emerging technologies which have reasonable promise of availability in the early 1980's. A specific study ground rule was that no detailed "Black Box" design was to be undertaken.

2) STUDY PROCESS FLOW

Figure 1-1 shows the design process flow used to develop the study. The study was divided into five major phases, Indoctrination, Definition, Study, Design, Documentation. The order of these phases received chronological emphasis although the nature of the study was such that considerable feedback was in evidence.

During the indoctrination phase basic data was assimilated from related studies and available agency files. This included a tour of the DEWLine by a representative study team member.

The definition phase resulted in the establishment of the baseline system, station concept, equipment configuration, life cycle cost model, reliability maintainability concepts and logistic concepts.

The balance of the study modified the plan slightly in that the outcome resulted in a number of concepts and alternatives rather than a single specific design.

STUDY PROCESS FLOW

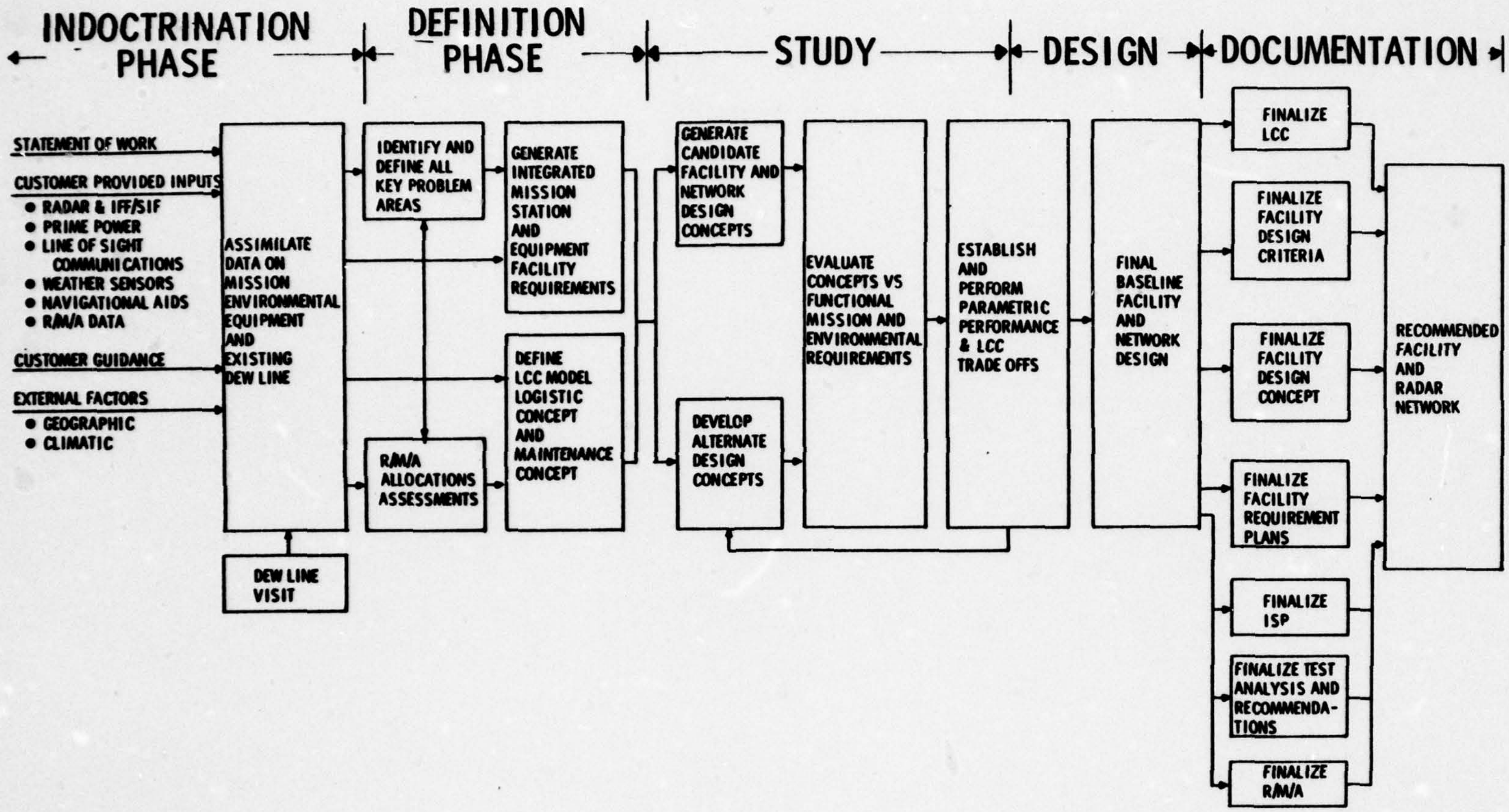

FIGURE 1-1

SECTION II

UNATTENDED RADAR STATION CONCEPTS

1) BASELINE SYSTEM

A baseline system was initially established as a reference point from which the study would evolve. It was comprised of a line of 83 unattended radar stations and 6 maintenance nodes utilizing operating and abandoned DEW Sites and additional previously identified site locations extending from Cape Dyer, Baffin Island southward to St. Anthony, Newfoundland. Initially 6 maintenance nodes were arbitrarily identified as the 6 operating main stations (POW, PIN, BAR, CAM, FOX, and Dye,-Main). Typically, each node serviced 14 adjacent unmanned stations spaced by 50 nm intervals and linked by a LOS (Line of Site) microwave relay system.

Typical unattended radar characteristics and cost were provided by the Government as a result of previous studies which established concepts for unattended radars. General Electric was a participant in these studies. Consequently we were able to utilize our radar concept in the station development since it fit within these characteristics identified in Figure 2-1. Other related Government sponsored studies such as the ERDA (Energy Research & Development Adm.) Power Study were factored into the baseline system to avoid study duplication.

2) COST DRIVERS

With the establishment of a baseline system the next major concern became that of identifying the cost drivers and determining their impact on system concept and life cycle cost - Figure 2-2 identifies the cost drivers correlated with their significant

PROJECT E259 TYPICAL RADAR

CHARACTERISTICS & COSTS

RADAR FREQUENCY	L-BAND
RADAR RANGE	60 NAUTICAL MILES
RADAR POWER CONSUMPTION	600 WATTS TO 1500 WATTS
ANTENNA TYPE	CYLINDRICAL ARRAY
ANTENNA SIZE	6' X 18' TO 7' X 30'
ANTENNA WEIGHT	5K POUNDS
RADOME WEIGHT	5K POUNDS TO 12K POUNDS
RADAR & IFF EQUIPMENT WEIGHT	5K POUNDS TO 10K POUNDS
TOWER TYPE	SQUARE FREE STANDING
TOWER HEIGHT	25' TO 125'
TOWER WEIGHT	40K POUNDS TO 60K POUNDS
TOTAL SYSTEM WEIGHT	60K POUNDS TO 80K POUNDS
RDT&E RADAR COSTS	$25M (2 DIFFERENT PROTOTYPES)
PRODUCTION RADAR COSTS	$1.5M (79 UNITS)
ANNUAL RADAR O&M COSTS	$1.5M

FIGURE 2-1

IDENTIFICATION OF COST DRIVERS

COST DRIVERS	COST IMPACT
● TOWER HEIGHTS	ACQUISITION
● NEW SITES REQUIRED	ACQUISITION
● MAINTENANCE CONCEPTS	O&M
● STATION RELIABILITY VS MAINTENANCE	ACQUISITION VS O&M
● NETWORK CONFIGURATION & MAINTENANCE	
- REDUCED LOGISTICS NODES ALTERNATIVE	O&M
● SUPPORT PERSONNEL REDUCTION	O&M
- REDUCED LOGISTICS NODES	
- ROVING MAINTENANCE TEAMS	
● COMMUNICATIONS APPROACHES	ACQUISITION & O&M
● HELICOPTER CANDIDATES	O&M
● POWER GENERATION	O&M

FIGURE 2-2

impact areas. The most critical of these was the O&M (Operation and Maintenance) manning requirements and transportation. These were a major consideration in the reliability analyses and the development of a system maintenance concept.

3) NODE CONSIDERATIONS

Three major concerns in developing minimally manned node concepts were the utilization of available resources, transportation, and the handling and storage of fuel.

Canadian Arctic development was investigated to determine the availability of resources and to identify potential future expansions. Available resources were particularly important in the consideration of air transport, resupply, and site maintenance. Figure 2-3 shows locations of some of the resources found on, or adjacent to the line. PIN-Main and Dye-Main are identified for reference purposes and are not considered as resources. A significant concern is the availability of airdromes, commercial power and fuel to support maintenance aircraft (helicopter) and personnel requirements. This impacted in the selection of maintenance support aircraft. Recent airdrome developments at Pangnirtung and Broughton Island alleviated some of the concern for aircraft support of the southeast extension. However, the support capability from Cape Dorset to St. Anthony remains marginally acceptable.

It was also determined that Canadian MOT (Ministry of Transportation) personnel manned some of the airstrips located along the DEWLine such as Tuktoyaktuk, Cambridge Bay, and Hall Beach. It was further determined that because of Arctic development these airdromes would remain manned independent of DEWLine disposition.

CANADIAN FACILITIES

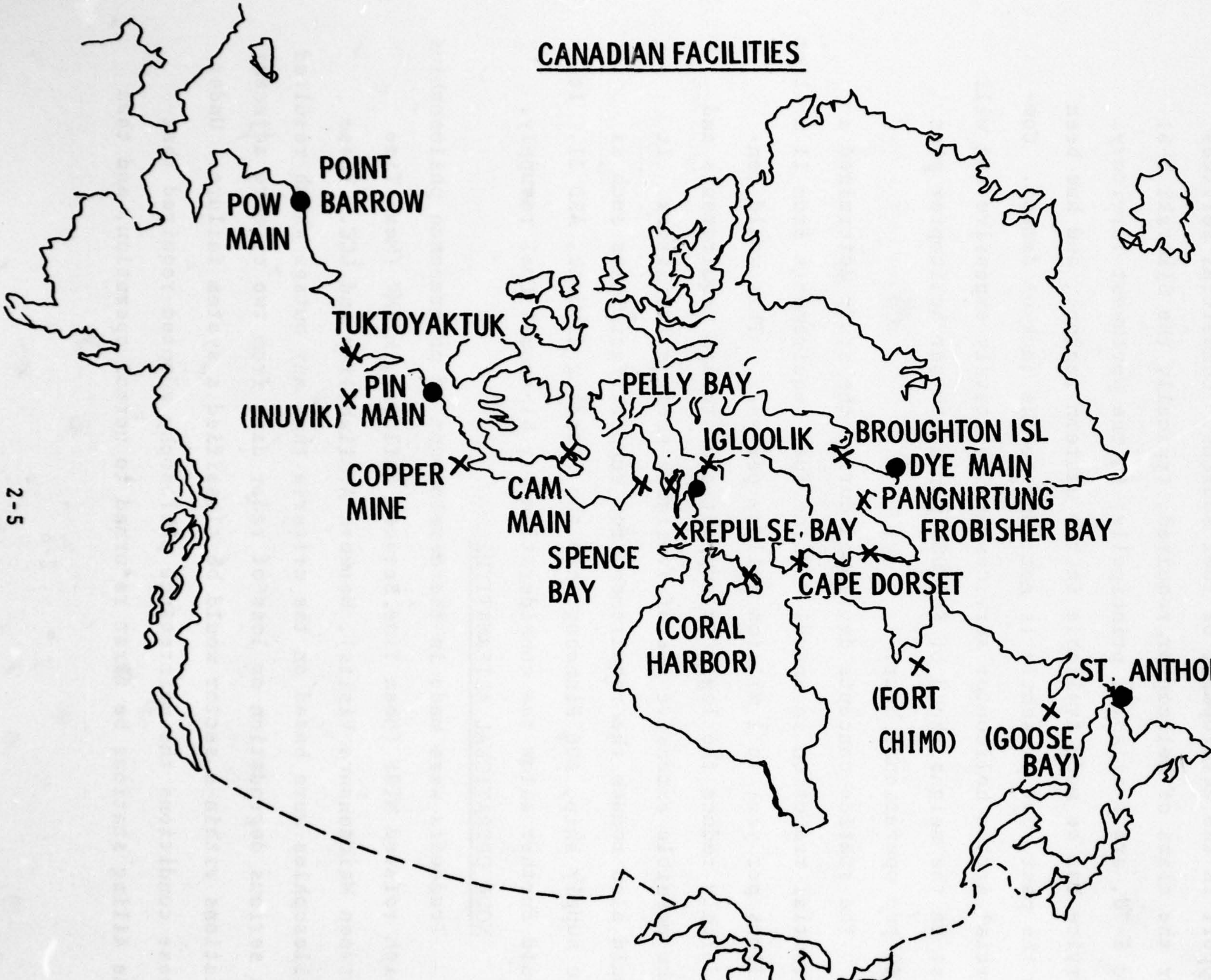

FIGURE 2-3

Arctic helicopter utilization was similarly examined and yielded some interesting results. Year around helicopter utilization in the Arctic is an established fact. This is due primarily to helicopter support in the development of fuel sources. Commercial services for the class of helicopter required, typically the Sikorski S-61 and S-76, are available, principally; in the Northwest Territory. Service can be made available in the eastern regions, and has been in the past, but presently is not; due to the lack of demand. Commercial Arctic helicopter services are relatively expensive and will cost in the neighborhood of $60,000 per month per helicopter plus $280 per operational hour.

The station concepts developed during the study determined a potential reduction in annual DEWLine fuel requirements from 11 million gallons per year to 1 million gallons per year. This would considerably reduce the logistic support and storage requirements and make possible extensive use of available storage facilities. It would also reduce the requirement for support facilities such as the supply ship, A06 Pinnebog; and the floating drydock, ARD 31. It would further allow the consideration for bi-annual fuel resupply.

4) NODE OPERATIONAL ALTERNATIVES

Tradeoffs were made in the development of maintenance philosophies which related MTBF (Mean Time Between Failure), MTBMV (Mean Time Between Maintenance Visits), Network Availability and LCC. These philosophies were based on the criteria that any outage which resulted in serious degradation or loss of radar data from two or more adjacent stations within a sector would be classified a system failure. Under these conditions the maintenance philosophy adopted required that the ailing stations be first returned to normal operation, and then all remaining stations in the sector be visited and preventative maintenance accomplished. Barring a system failure, so described, preventative maintenance would be accomplished during the annual or bi-annual resupply visit. As a result of the previously described analysis and investigations, node operational alternatives were developed. These are shown in Figure 2-4.

The baseline and first four alternatives all include at least 6 helicopters. The second, third, fourth and sixth alternatives include additional shuttle aircraft. These may be helicopters. The fifth and sixth alternatives utilize four helicopters. In addition each alternative can utilize either LOS microwave or satellite except the fourth and sixth alternatives which require satellites communications.

The baseline system utilizes the existing main sites for the nodes; with each node having complete data maintenance, helicopter and air crew capability.

Alternate 1 is similar to the baseline with two exceptions. Bar 3, (Tuktoyaktuk) is utilized in place of Pin-M to take advantage of the fuel staging capability and MOT manned airstrip. Dye-M is replaced by Ft. Chimo as a Data node and Goose Bay as a maintenance node. This is to take advantage of existing facilities, and would have an advantage utilizing the satellite approach.

Alternate 2 is the first of the roving team concepts. It takes advantage of the airdrome manning available at the sites. Conversation with DND indicates that these airstrips would remain manned regardless of DEWLine presence. This alternate has two full maintenance crews centrally located at CAM-M with a helicopter and crew chief located at the other nodes. Any required maintenance action would require maintenance team shuttling to the closest node.

NODE OPERATIONAL ALTERNATIVES

ALTERNATIVES	POW-M*	BAR-M	BAR-3*	PIN M	CAM-M*	FOX-M*	DYE M	FT CHIMO*	GOOSE BAY*	NO HELICOPTER
BASELINE	X	X		X	X	X	X			6
1) OPTIMIZED FULL	X	X	X		X	X		D	M	6
2) ROVING TEAM	D	D	D		X	D		D		6+S
3) ROVING TEAM	X	D	D		X	D		D		6+S
4) ROCC-DATA	M	M_A	SUP		M	SUP		H		6+S
5) REDUCED FULL	X	M_A	X		X			X		4
6) REDUCE-ROCC DATA	M		SUP		M			SUP		4+S

* - AIRPORT MAINTENANCE OTHER THEN DEW
X - DATA AND MAINTENANCE
D - DATA
M_A - MAINTENANCE AIRSTRIP
M - FULL MAINTENANCE
SUP - SUPPLY ONLY
S - SHUTTLE
H - HELICOPTER + CREW CHIEF

FIGURE 2-4

Shuttling could be accomplished by winged craft or helicopter.

Alternate 3 is similar but recognizes Alaskan/Canadian sovereignty. A single full maintenance team is now located at POW-M (Pt Barrow to handle all of Alaska.)

Alternates 4 & 6 allow data reduction at a single position such as a node or the ROCC. The only personnel left on the line are maintenance personnel, a full maintenance team at POW-M and CAM-M, an airstrip maintenance team at BAR-M, supply services at BAR-3 and FOX-M and a helicopter with crew chief at Ft. Chimo.

Alternate 5 is similar to alternate 1 except it utilizes four full maintenance teams on the line.

Alternate 6 reflects the ultimate to be achieved in reduced manning if projected reliability and availability can be achieved. This alternate has two teams at CAM-M with one Team at POW-M. They would be controlled from the ROCC.

5) COMMUNICATION CONSIDERATIONS

A major concern addressed during the study was communication between the unmanned stations and the manned maintenance node. These links not only have to supply radar data, but are the means for communicating station status and control, as well as human communications during aircraft transit and maintenance visits.

Figure 2-5 shows the circuit requirements among the various sites in the network. The number of circuits between each location is identified by the number enclosed in circles or ellipses. The 83 unmanned sites are divided into six segments as shown at the top. Seven circuits from each of the unmanned sites are routed by separate paths to two manned logistics nodes. The manned nodes are interconnected by a circuit switch with three circuits from each

CIRCUIT REQUIREMENTS

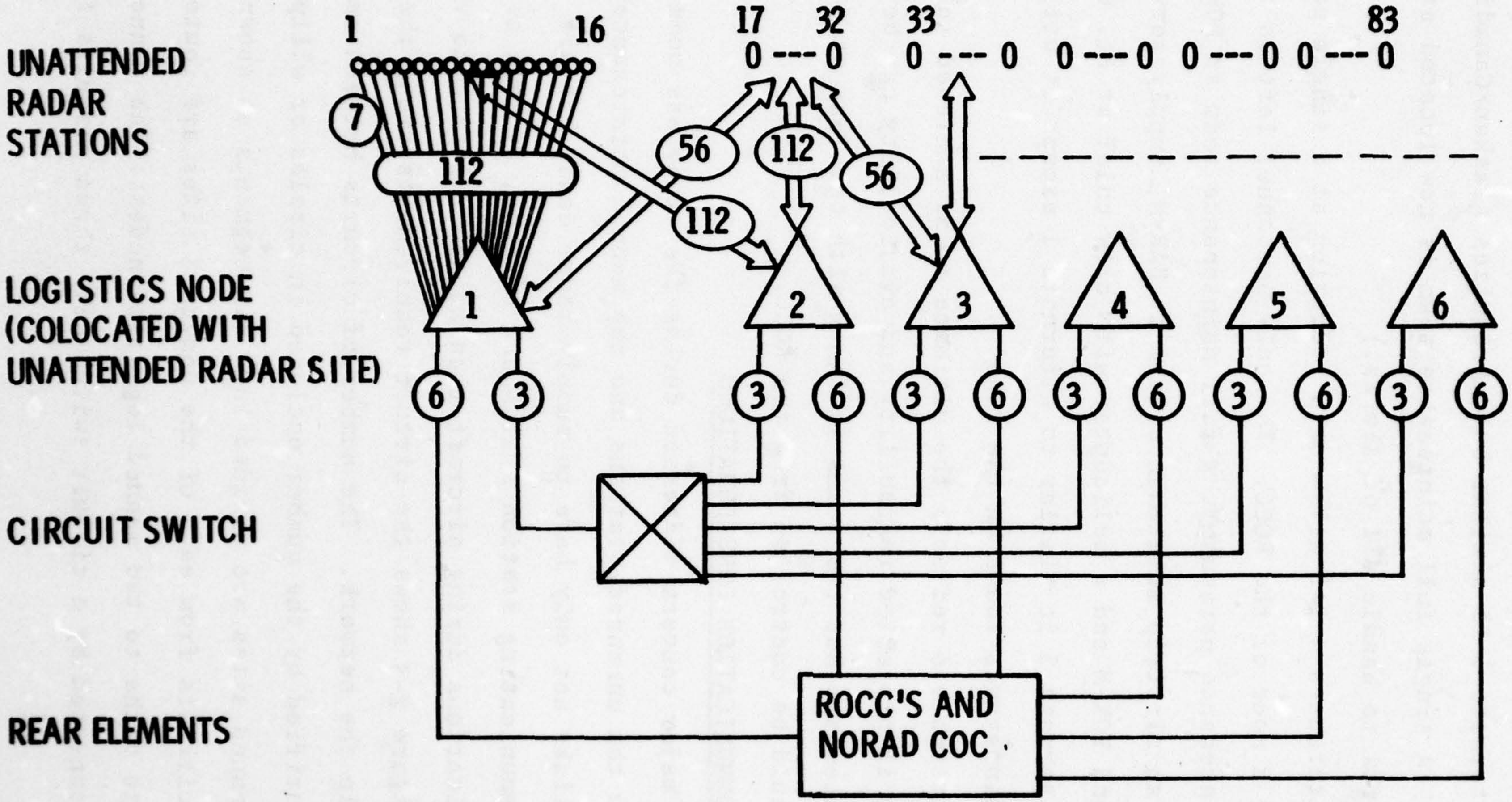

FIGURE 2-5

manned node. Six circuits are also routed from each manned node to one or more of the rear elements.

The communication or interface with the ROCC was a given assumption and not a requirement of this study.

The baseline communications system was established by direction as a microwave LOS system utilizing intermediate repeaters between stations. All facets of the study are referenced to this system. A major drawback with the microwave LOS system is the number of long haul water crossings which would require alternate routings or different implementations such as satellite or troposcatter.

Although the LOS scheme can be implemented the recommended system is the satellite system shown in Figure 2-6. This scheme has several advantages.

It results in minimum life cycle cost, requires few maintenance actions and allows simple station configurations. It provides security options since it can be used to provide television and phone communications to adjacent communities.

In an all satellite implementation, each of two satellites is available to each ground station, providing redundant routes for radar data. An attractive alternative requiring less hardware per site is alternating satellites utilized per station along the line. In the further implementation, loss/degradation of data from adjacent radars can only occur in the event of failure of a station (prime power or radar or communication), or in the extremely unlikely event of failure of both satellites.

6) UNATTENDED STATION IMPLEMENTATION

The primary functional areas comprising an unattended radar station are shown in Figure 2-7. An analysis of these areas indicates the only major development requirement is that for the radar and IFF.

SATELLITE COMMUNICATIONS NETWORK

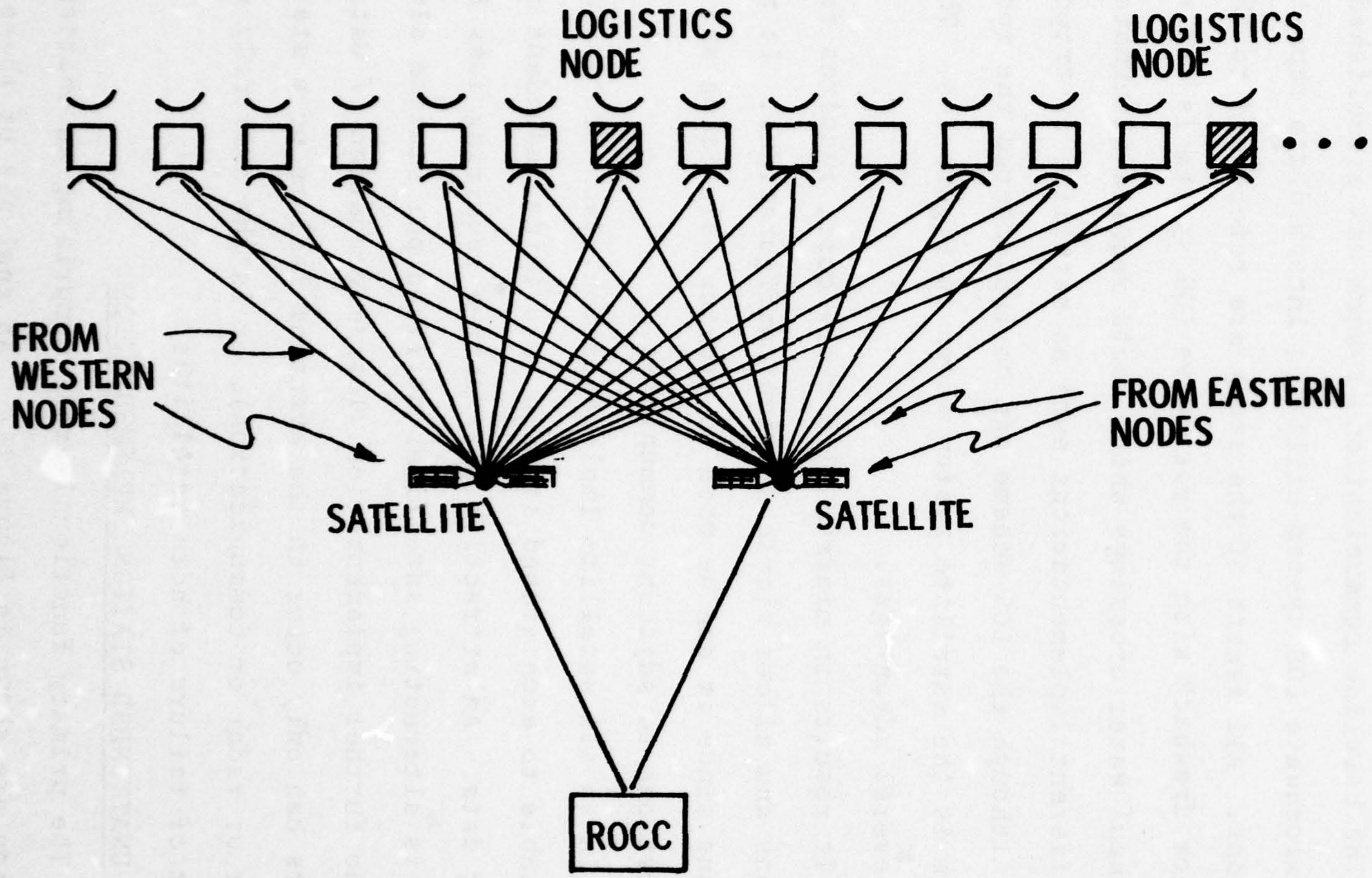

FIGURE 2-6

UNATTENDED RADAR STATION FUNCTIONAL EQUIPMENT AREAS

FUNCTIONAL AREA	FUNCTION
1. RADAR/IFF	DETECT, TRACK, AND IDENTIFY TARGETS
2. WEATHER STATION	REPORT WEATHER HOURLY AND ON COMMAND
3. NAVAIDS	PROVIDE NAVIGATIONAL AIDS FOR GENERAL AVIATION AND MAINTENANCE MISSIONS
4. SECURITY SYSTEM	PROTECT AGAINST FIRE AND INTRUSSION
5. COMMUNICATIONS	PROVIDE VOICE AND DATA COMMUNICATION BETWEEN UNATTENDED STATION AND MANNED NODE
6. STATION CONTROL	CONTROL STATION FUNCTIONS, MONITOR PERFORMANCE, FAULT LOCATION, DATA INTERFACING, AND DATA STORAGE
7. PRIME POWER GENERATION	STORE FUEL, GENERATE AND CONTROL PRIME POWER
8. ENVIRONMENT CONTROL	IMPLEMENT TOTAL ENERGY CONCEPT TO STATION ENVIRONMENTAL CONTROL

FIGURE 2-7

The remaining areas for the most part can be designed from commercially available components and may require some minor interface development.

The unattended station configured using the stated functional areas was accomplished within the power budget shown in Figure 2-8.

The first line under normal load summarizes the power generating capabilities of the ST1 Generator at 1800 rpm. The second line shows the full time station load, and the third line the peak demand. As may be seen the generated power and loads are an excellent match. Using the combined power of two Diesels the match of maintenance load to power available is also an excellent match.

The resultant station designs are based on total energy considerations. That is, equipment selection and station packaging are such that no additional fuel would be required for equipment heating or air conditioning.

A general concern for the placement of unattended stations was radar tower and shelter design. This concern centered around, security accessibility, and maintenance support. A large number of designs were examined and alternatives are described in the final report which range in complexity from simple shelters under the radars to radar platforms that are only helicopter accessible thereby providing maximum intruder security. The recommended design is a unitized concept embodying an entire station within the radome.

This combination of the electronic, power and life support functions in one shelter provides a compact and simplified design that satisfies the individual requirements in a single unit. All of the equipment will be installed and tested in a factory environment. The module would then be packaged into six transportable sections with temporary wall panels as required. At the job site

STATION OPERATIONAL PRIME POWER BUDGET

	MINIMUM IN KW	FULL LOAD IN KW	OVERLOAD IN KW
NORMAL LOAD			
POWER AVAILABLE FROM GENERATOR	3.1	4.4	4.8
FULL TIME LOAD	3.1		
MAXIMUM INTERMITTENT LOAD		4.2	
MAINTENANCE LOAD			
POWER AVAILABLE FROM GENERATORS	6.2	8.8	9.6
FULL TIME LOAD	6.3		
MAXIMUM INTERMITTENT LOAD		8.7	

FIGURE 2-8

the six sections would be emplaced on the supporting tower by helicopter and fastened together to form the unitized station.

These stations are adaptable to a range of tower designs as shown in Figures 2-9 and 2-10, which depict the recommended satellite supported configurations on a tall tower installation and as a retrofit on existing DEWLine towers respectively.

TALL TOWER

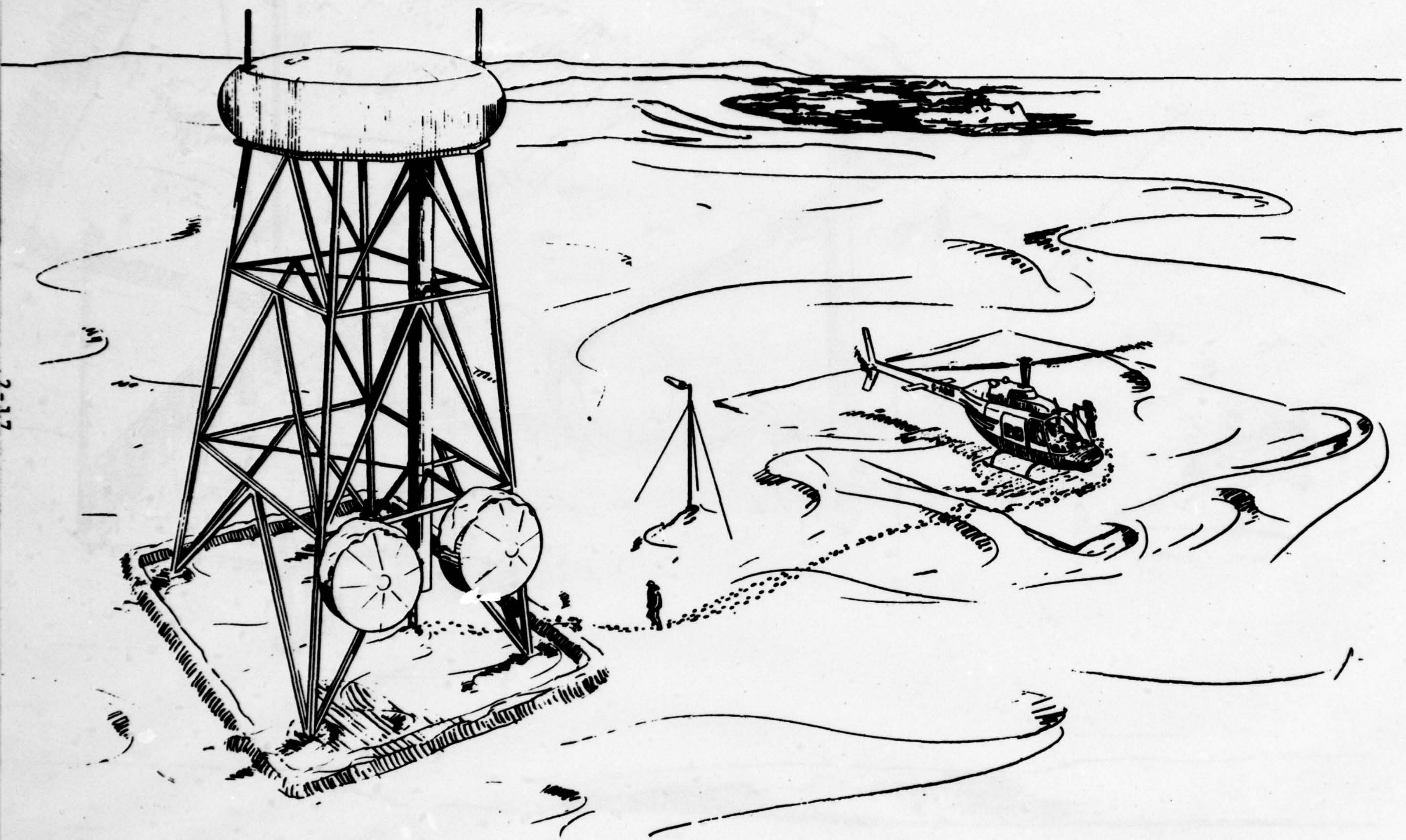

FIGURE 2-9

EXISTING PLATFORM

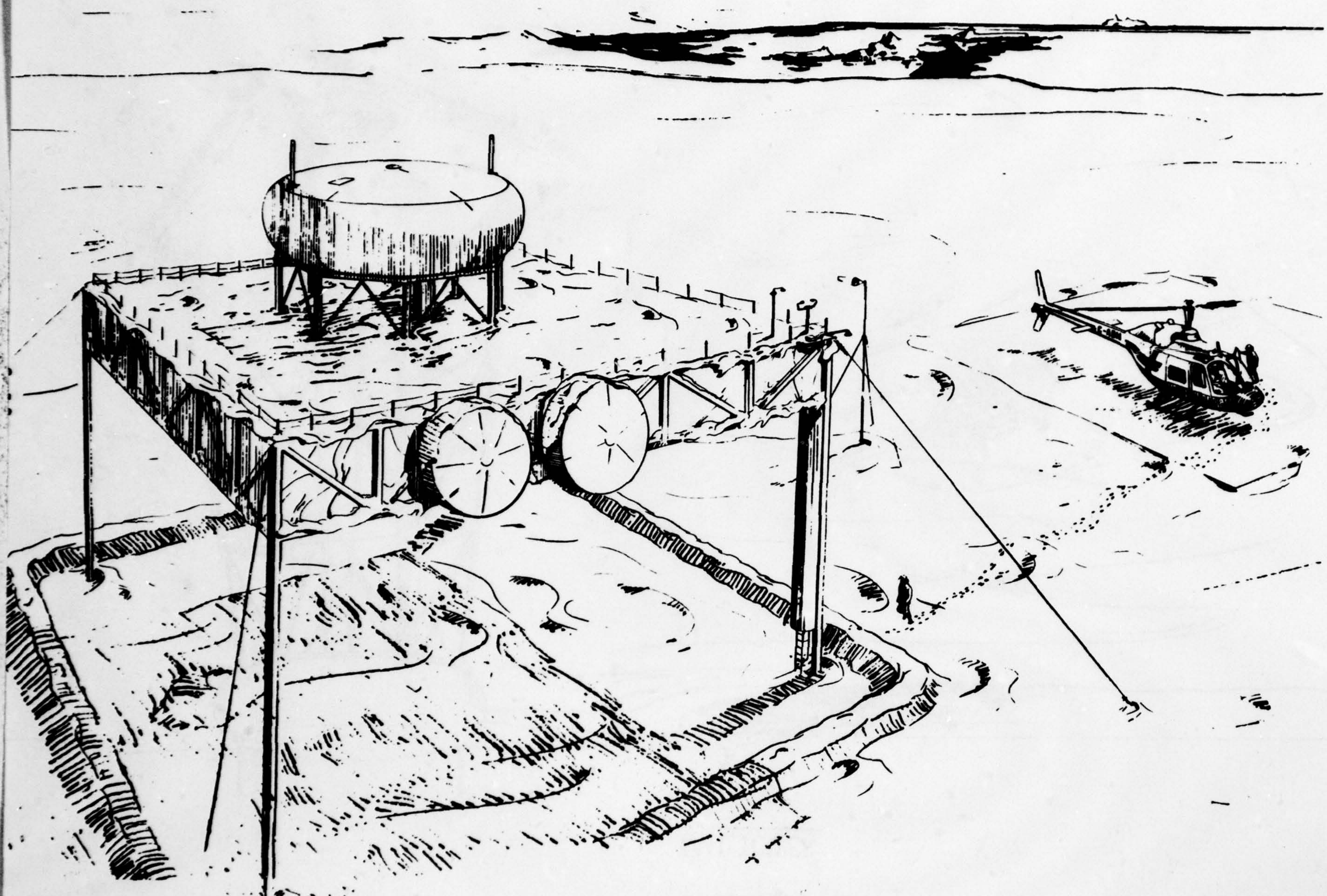

FIGURE 2-10

SECTION III

LIFE CYCLE COST

This section presents the life cycle cost for certain key alternatives. The details used for arriving at these cost estimates are contained within Section II of the final report. The cost were arrived at through the determination of specific cost factors in an ascribed model.

The first item of Figure 3-1 shows the cost for the line of site microwave system which is the reference for all configurations.

The second item shows the cost that would result through satellite utilization in place of microwave LOS.

Alternates 3 and 6 show the further cost savings to be realized by implementing a roving team maintenance concept for the satellite configured system. Of these, alternate 6 represents an end point solution that would be attained if the total reliability projected for the stations could be realized. It is the recommended approach that should be strived for.

LIFE-CYCLE COST

	$(MILLION)
BASELINE LOS MICROWAVE	319
BASELINE SATELLITE	309
ALTERNATE 3 - ROVING TEAM - 6 NODE	238
ALTERNATE 6 - ROVING TEAM - 4 NODE	192

FIGURE 3-1

SECTION IV

CONCLUSIONS AND RECOMMENDATIONS

1) CONCLUSIONS

Figure 4-1 list the major accomplishments summarily described in this document and detailed in the final report. There were many additional accomplishments in support of those shown which helped to lead to the conclusions of Figure 4-2.

We believe that this study, in conjunction with previous studies such as the Unattended Radar, Communications, and Power studies, has addressed the major feasibility concerns relative to unattended Arctic Radar Stations. The analyses accomplished during the past five months are conservative and do not address the savings to be accrued based on policy decisions such as border sovereignty, continued support obligations (communications and weather reporting), and requirements to use existing facilities. For example, it is our understanding that the DEWLine provides the communications services for Pelly Bay. These could be eliminated or modified. However, agreements are involved. Similarly, there is considerable weather reporting presently provided by the DEWLine. This would be reduced in substance to that coming from the unattended stations. The personnel observations would essentially be reduced to the manned airstrips (6). The impact of this loss in view of new weather reporting systems is unknown. In addition, there are communication traffic routes utilizing the present tropo systems. This study assumes the retirement of these systems.

The remaining technical concerns are few. The radar station designs and radars were based on a given model which may be modified in the near future. The actual radar requirements are yet to be firmed. Technologically those that have been conjectured do not

<u>SUMMARY OF MAJOR STUDY ACCOMPLISHMENTS</u>

- IDENTIFIED MAJOR COST DRIVERS AND DEVELOPED REDUCTION OPTIONS
- ESTABLISHED FEASIBILITY OF ARCTIC HELICOPTER UTILIZATION
- DEVELOPED MINIMUM MANNED NODE CONCEPTS
- ESTABLISHED FEASIBILITY OF UNATTENDED RADAR STATION
- DEVELOPED STATION DESIGNS AND STRUCTURAL CONCEPTS (SECURE, ADAPTIVE, TRANSPORTABLE, MODULAR, UNITIZED)
- DETERMINED UNMANNED STATION EQUIPMENT CONFIGURATIONS AND REQUIREMENTS
- BASED STATION DESIGN ON TOTAL ENERGY CONCEPT
- INTRODUCED INTERLEAVED SATELLITE CONCEPTS AND ESTABLISHED SATTELITE SUPERIORITY
- COMPLETED RELIABILITY/MAINTAINABILITY ANALYSIS AND LIFE CYCLE COST
- ACCOMPLISHED PRELIMINARY COMMUNICATIONS STUDY

FIGURE 4-1

CONCLUSIONS

- AN UNATTENDED NETWORK IS FEASIBLE
  - TECHNICALLY
  - ECONOMICALLY
- THE ANALYSES PRESENTED ARE CONSERVATIVE
  - POLICY
- REMAINING CONCERNS ARE PRIMARILY POLICY RELATED
  - ARCTIC COMMUNICATIONS
  - HOURLY WEATHER REPORTING
  - EXISTING TRAFFIC ROUTES
- REMAINING TECHNICAL CONCERNS ARE:
  - FIRMING OF RADAR REQUIREMENTS
  - DEVELOPMENT OF UNATTENDED STATION
  - DEVELOP BACK-UP COMM LINK

FIGURE 4-2

add technical risk to the program but could change power requirements and processing requirements. The development of the unattended station is primarily a concern in that it still remains to empirically validate the analyses which resulted from these analytical studies. Additional Communications Link backup should be a consideration and is addressed under recommendations.

2) RECOMMENDATIONS

The recommendations to come out of this study are divided into two groups, those directed toward system implementation, and those directed toward program considerations. These are listed in Figures 4-3 and 4-4 respectively.

The study primarily addressed concerns and alternatives, and the generation of feasibility concepts. The choice of concept may have other considerations than those used to establish the study. For that reason, none of the concepts is addressed as being the only viable approach. However, under the ground rules of the study our recommendation is that Alternate 6, which is a roving team satellite approach with all data returning to the ROCC; as the most effective approach. It has least life-cycle cost, and requires minimum manning and logistics support.

In light of the significantly reduced logistics support compared to present line requirements, multi year reduced supply options should be considered. These would be governed primarily by QC storage and testing requirements. There are facilities available at communities on the line that should be considered. It is conceivable that reduced logistics requirements might make it advantageous to co-locate personnel within these communities and utilize purchased power, and community resources.

UNATTENDED RADAR STATION - RECOMMENDATIONS

- IMPLEMENT ROVING TEAM SATELLITE CONCEPT
- CONSIDER MULTIYEAR REDUCED SUPPLY OPTION
- UTILIZE AVAILABLE COMMUNITY AND AGENCY RESOURCES
- UTILIZE HELICOPTER TRANSPORTATION ONLY
- REDUCE NUMBER OF PACER OPERATIONS TO TWO
  - PACER MACK
  - PACER DEW BASIN
- OPTIMIZE UNATTENDED SITE LOCATIONS RELATIVE TO RADAR SYSTEM REQUIREMENTS

FIGURE 4-3

The existence of communities and the increase in Arctic activity make it feasible, technically, to utilize helicopter transportation only, although, at present, this is not without concern. Most helicopter activity is located around the oil fields of the Northwest. This area offers possibilities for charter trade considerations as a function of maintenance policy. The remainder of the line, however, would require dedicated service which can be made available. Helicopter facilities become less available toward the east. What will eventually be the greatest concern will not be the Arctic, but the Laborador Coast between Hopedale and Frobisher Bay.

Reduction in POL requirements will alter the reduction of the PACER operations to two, and it is even conceivable that they can eventually be reduced to one.

This study did nothing relative to evaluating site selection relative to radar coverage. It is recommended that, in the future, site analyses should be accomplished to locate the radars where they could be most affective relative to minimum tower height and maximum terrain elevation. Every advantage should be made of the expected system reliability.

The program recommendations detailed in Figure 4-4 come about primarily from observations made during the unattended station study.

The unattended station study did not address future radar requirements for the DEW system. These were specified as previously shown. These requirements should now be made firm and tested against the conceptual alternatives presented by the station study to determine their impact on concept and life cycle cost.

A communication study should be initiated in which backup modes are to be used for the communications system. This should include the possibility for utilizing the VLF Beacon system and the radars

PROGRAM RECOMMENDATIONS

- ESTABLISH REQUIREMENTS FOR UNATTENDED DEW RADAR SYSTEM
- INITIATE COMMUNICATION STUDY
    - CONSIDER VLF BEACONS FOR DATA BACKUP
    - RADAR AS DATA LINK
- INITIATE RADAR/IFF STATION DEVELOPMENT PROGRAM IN PARALLEL WITH COMMUNICATION STUDY
- DETERMINE INTERFACE REQUIREMENTS AND SPECIFICATIONS WITH THE ROCC
- ESTABLISH A PANEL TO REVIEW AND EVALUATE APPLICABLE TECHNOLOGY ADVANCES AND IMPACT
    - METHANOL FUEL CELL
    - UNATTENDED WEATHER STATION
    - COMM GEAR DEVELOPMENT

FIGURE 4-4

themselves. These require some investigation.

It is not envisioned that operational requirements for an unattended radar would undergo any changes in principle. On this basis and because of the developmental nature of the radar and integrated IFF, consideration should be given to initiating a prototype unattended station development in parallel with other recommended actions.

The reliability aspects of the unattended station have yet to be demonstrated by hardware implementation short of individual component evaluation. Whereas the mathematical models indicate feasibility, acceptable demonstrations will require time and development. Timely system deployment at minimum risk suggest early station implementation. The required technology and components are available.

In addition ROCC interface requirements should be established relative to ROCC data requirements so that their impact can be factored into station design.

And last, a technical review panel with industry liaison should be established to consider the impact of merging developments, some of which are listed.